OPERATING AND SERVICE MANUAL

352A
TRANSDUCER
INDICATOR

BLH ELECTRONICS, INC.
A subsidiary of Baldwin • Lima • Hamilton Corporation
WALTHAM, MASSACHUSETTS 02154 • (617) 894-6700

TM-352-1

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BLH MANUAL CHANGES

MODEL 352

MANUAL TITLE Transducer Indicator

MANUAL PREFIX TM-352-1

MAKE ALL CHANGES IN THIS MANUAL ACCORDING TO ERRATA AND CHANGE(S) LISTED BELOW

CHANGE 1: Change Model Number from 352 to 352A.

Page 4-2, SECTION IV, MAINTENANCE, Figure 4-1, Schematic Diagram. Eliminate designation: "Eveready #2317."

Page 5-1, SECTION V, REPLACEABLE PARTS, Figure 5-1, Parts List. Under "Description" change: "6 Volt Battery, Eveready #2317" to: "Four 1-1/2 Volt "C" Cell Batteries."

July 1967
DATE

1
CHANGE NUMBER

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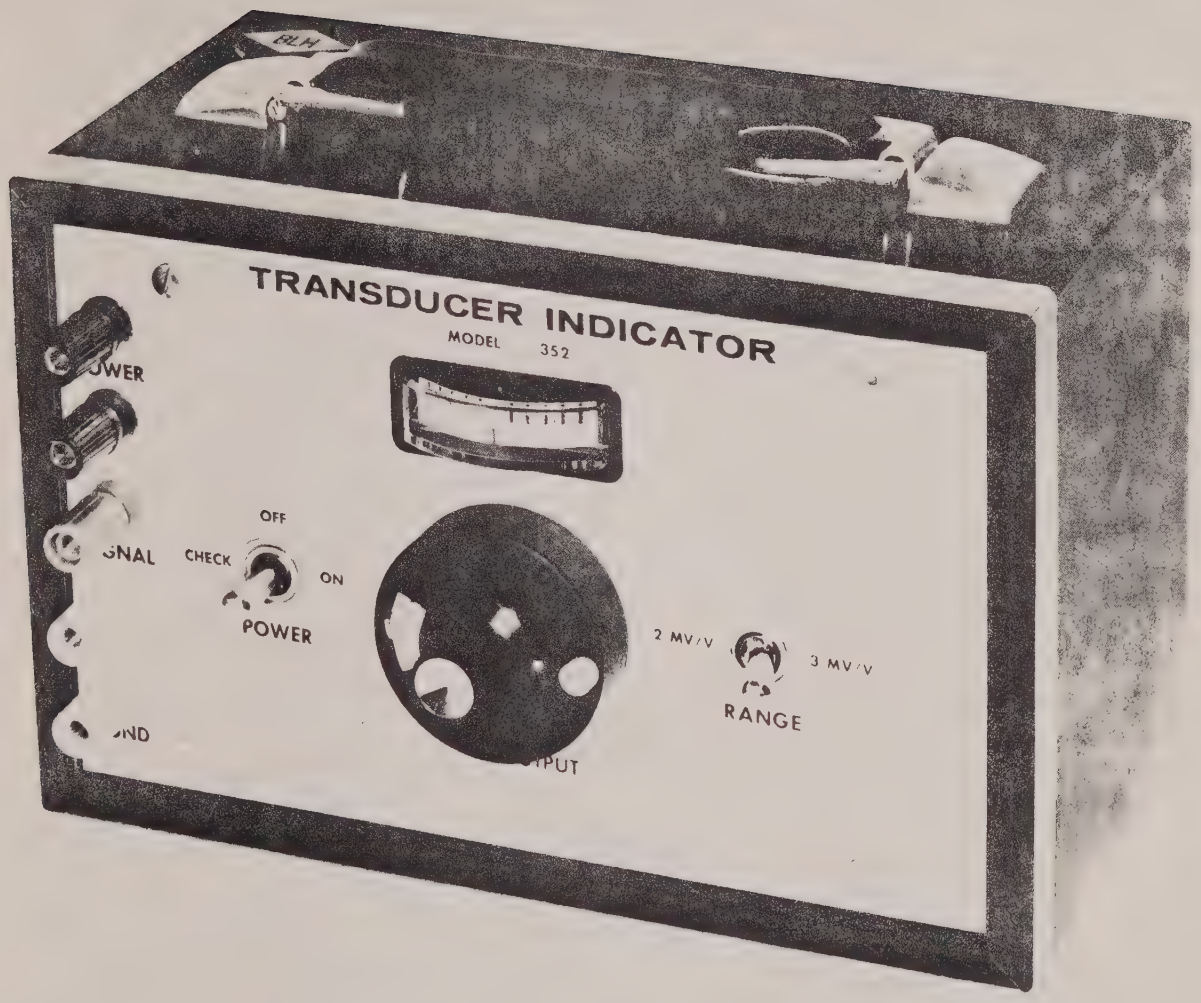

Figure 1-1. Model 352 Transducer Indicator

SECTION 1
GENERAL INFORMATION

1.1 General

The BLH Model 352 Transducer Indicator, Figure 1-1, is a manually-null-balance, portable, compact, percent reading instrument. A two-position MV/V range selector switch located on the instrument front panel, makes this instrument universal in application. The Indicator is completely transistorized and is designed for trouble-free service under difficult field conditions.

1.2 Description

The Model 352 Transducer Indicator is a portable battery-operated unit with duo-dial readout in percent of Transducer output. Absolute readout permits quick, accurate readings without potential parallax and interpolation errors.

The circuit includes a six-volt DC-AC inverter, transistorized amplifier, demodulator, null meter and measuring circuit.

See THEORY OF OPERATION for a detailed circuit discussion of the Model 352.

1.3 Applications

The Model 352 is used for checking or balancing Transducer output of a single or multiple Transducer system. Designed primarily for use with any BLH Transducer, it may be used with any other resistance Transducers within the range of the instrument.

1.4 Specifications

Bridge Resistances:	120 ohms or 350 ohms
Range:	2 mv/v and 3 mv/v
Repeatability:	0.1%
Readability:	0.05%
Accuracy:	±0.5%
Readout:	0-100%, Ten turn, duo-dial
Linearity:	±0.25%
Dimensions:	8-1/2" wide by 5-1/4" high by 4-1/4" deep
Power:	Internal six-volt battery
Excitation:	3 volts, 1,000 cps

Connections: 3-Way Binding Posts

Black & Green:	Transducer excitation
Red & White:	Transducer signal
Yellow:	Ground

SECTION 2

OPERATION

2.1 General

This section provides information covering unpacking, packing, inspection after shipment, initial application of power and general operation. Please read the paragraphs on General Operation before energizing the Transducer Indicator.

2.2 Unpacking Instructions

There are no special instructions required; simply use standard unpacking procedures.

2.3 Packing the Transducer Indicator for Shipment

If you return the Transducer Indicator to Baldwin-Lima-Hamilton during the equipment warranty period, be sure to follow these instructions carefully to avoid transportation damage which might NOT be included in the warranty. Contact Baldwin-Lima-Hamilton or your nearest authorized BLH Representative. Explain the difficulty so that BLH or an authorized Representative may determine the return procedure which will provide the quickest service for you. Generally, the local authorized BLH Representative can remedy the problem without removing the equipment from your plant. In the rare case where it becomes necessary to actually ship the faulty unit, please follow the remaining steps. Baldwin-Lima-Hamilton will rush you instructions as to speedy shipment and insurance requirements. DO NOT SHIP EQUIPMENT UNTIL THESE INSTRUCTIONS HAVE BEEN RECEIVED BY YOU.

1. Carefully inspect the Transducer Indicator for loose items. Secure any loose components.

2. Obtain a shipping container which is sufficiently large to permit one inch of shock absorbing padding to surround the unit. Suitable padding materials are:

   a. Shredded newspaper
   b. Crumpled newspaper
   c. "Kimpak"
   d. Excelsior, either wood or paper
   e. "Rubber Hair"

3. Prior to putting the Transducer Indicator in the inner container, wrap the unit in paper or place it in a bag to prevent damage during shipment.

4. Place the inner container in a larger box, surrounding the inner box with at least 1 inch (top, bottom and sides) of the same isolating material.

5. Address the box. Containers of 2 cubic feet or more should have address labels on at least two opposite sides.

6. Be sure to insure the shipment according to instructions sent by Baldwin-Lima-Hamilton.

7. The method of shipment depends on the costs involved and the urgency of the shipment.

2.4 Inspection After Shipment

Reasonable care has been taken to pack the Transducer Indicator in such a manner that it will reach its destination in perfect condition. However, to be sure that the instrument will function properly, check to see that it has not been damaged. There should be no dents, cracks, or breaks in the case.

2.5 Installation

2.5.1 Mechanical

The selection of a suitable location for the Indicator is important for satisfactory operation. The ideal location is a clean, dry room with uniform temperature. Locations where the Indicator will be subjected to temperatures above 110°F or below 32°F should be avoided.

2.5.2 Electrical, Connecting Transducer

For compression type Transducers, connect the Transducer to the binding posts, located on the left side of the front panel of the Indicator. The binding posts are color-coded to coincide with the color-coding of the wires in the Transducer cable. For universal Transducers where the Transducer is to be used in tension, reverse the RED and WHITE leads to the Indicator input terminal; cnnnect the RED Transducer lead to the WHITE binding post and the WHITE Transducer lead to the RED binding post.

2.6 Power Requirements

The Transducer Indicator operates with one 6-volt battery (Eveready #2317).

2.7 Description of Controls

A listing of the front panel controls and their functions is provided below. Before energizing the Model 352, the operator should become familiar with these controls and the operating instructions below:

NOTE: CAPITAL LETTERS indicate the exact front panel markings.

POWER

This switch controls the input power to the Indicator. An additional CHECK position provides a quick check of the battery output level.

% OUTPUT

This duo-dial control provides a means to balance the Transducer output and the measuring circuit output. When this balance occurs, the null-meter will null. The % Transducer output is read directly from the dials.

RANGE

This switch is used to select a measuring circuit excitation which is equivalent to the mv/v output of the Transducer used.

2.8 Operation

2.8.1 Battery Check

Prior to connecting the Transducer to the Indicator, place the POWER switch to the CHECK position. The null-meter needle should deflect to the right and beyond the red area. If the meter needle remains in the red area, the battery must be replaced. Refer to the section on maintenance for the battery replacement procedure.

2.8.2 Testing with No Tare Weight on Transducer

a. Turn the POWER switch to the ON position and allow a few minutes for the instrument to warm up.
b. Position the RANGE switch to the full scale output of the Transducer in use, 2 mv/v or 3 mv/v (refer to Transducer instruction sheet).
c. Apply the required load to the transducer.
d. Rotate the % OUTPUT dial clockwise until the null-meter needle is again on zero (center of meter scale).
e. The reading in percent of the Transducer's full scale output is read on the dial, each division is 0.1 percent.

2.8.3 Testing with Tare Weight on Transducer

a. Turn POWER ON and allow a few minutes for the instrument to warm up.

b. Position the RANGE switch to the full scale output of the Transducer in use, 2 mv/v or 3 mv/v. See Transducer instruction sheet.

c. With only the tare weight on the Transducer, rotate the % OUTPUT knob until the null-meter needle is on zero (center of meter scale).

d. Record the reading obtained on the dial. This is the tare weight, plus or minus initial Transducer unbalance, in percent of the Transducer's full scale output.

e. Apply load to the Transducer.

f. Rotate the % OUTPUT knob until the null-meter needle is again on zero.

g. Subtract the reading in (d) from the reading in (f). The difference is the additional weight on the Transducer.

h. On multiple Transducer systems, repeat the above procedure for each Transducer. The total tare weight and load is the sum of the individual Transducer readings.

NOTE: On multiple Transducer Systems, the Transducers should be spaced and shimmed so that they carry equal loads and provide outputs within 10 percent of each other.

2.9 Calibration

To check the calibration of the Transducer Indicator, it is necessary to have an accurately known mv/v source such as the BLH Precision Calibrator, Model 625. An alternate method is to apply an accurately known load to a calibration Transducer of at least 80 percent of its full scale and reset the instrument span if necessary.

To perform the calibration, using the Model 625 Precision Calibrator, proceed as outlined in the following steps:

a. Connect the precision calibrator to the Transducer Indicator. Both instruments have color-coded binding posts, connect color to like color. Either set of binding posts of the calibrator may be used.

b. Position the calibrator's TRANSDUCER RESISTANCE switch toward the set of binding posts utilized, 120 ohms or 350 ohms.

c. Position the calibrator's RANGE switch to the 0-2 mv/v range.

d. Position the calibrator's STEP switch to zero.

e. Position the RANGE switch on the Transducer Indicator to the 2 mv/v range.

f. Position the POWER switch on the Transducer Indicator to the CHECK position to determine if the battery voltage is at a satisfactory level, then position the POWER switch to the ON position. Allow a few minutes for the Indicator to warm up.

g. Rotate the % OUTPUT dial to 000. The null-meter needle should indicate zero (midpoint of meter scale).

h. If the null-meter does not read zero, remove the Transducer Indicator from its case by removing the four screws on the front panel and carefully slide the Indicator forward to expose the measuring circuit board on the left side of the Indicator.

i. With a jewelers screwdriver, adjust R102, ZERO adjustment, until the meter needle is on zero.

j. Position the STEP switch on the precision calibrator to 2 mv/v position.

k. Rotate the % OUTPUT dial to the 100 percent position. The null-meter needle should indicate null again; if this is not the case, adjust R101, SPAN adjustment, until the meter needle is at null.

l. Position the STEP switch on the precision calibrator to zero and recheck the zero of the Indicator. If a significant zero shift has occurred, repeat steps g thru k until no change occurs.

m. Replace the Indicator in its case and secure the four screws.

SECTION 3
THEORY OF OPERATION

3.1 General

The Transducer connected to the Model 352 produces an output voltage proportional to the load applied. The Indicator measures the voltage and translates this voltage into an indication in percent of Transducer output. See Block Diagram, Figure 3-1.

The circuitry of the Indicator includes a 6-volt DC-AC inverter, an amplifier, a demodulator, a null-meter and a measuring circuit. The inverter supplies power to the measuring circuit, Transducer, and reference winding of the demodulator. The difference between the Transducer output voltage and the measuring circuit voltage is fed to the amplifier. The amplifier output is fed to the demodulator, producing a DC voltage. This voltage is dependent upon the magnitude and polarity of the difference between the Transducer and measuring circuit voltages. The duo-dial, attached to the slidewire, is rotated, manually to bring the meter to its null. The resulting indication on the duo-dial is the magnitude of the Transducer output. The dial has a scale of 0-100 percent in steps of 0.1 percent.

3.2 Indicator Measuring Circuit

The Transducer Indicator uses a measuring circuit based on the null balance principle. See Figure 3-2. This circuit consists of a resistance balancing network and an electronic amplifier. The bridge of the Transducer sensing element is electrically connected to this measuring circuit. The amplifier operates from the measuring circuit to drive the meter to a position determined by a slidewire coupled to the % OUTPUT control. Any difference in voltage output between the instrument and the Transducer is amplified and sent to the null-meter. Operating the % OUTPUT control moves the brush on

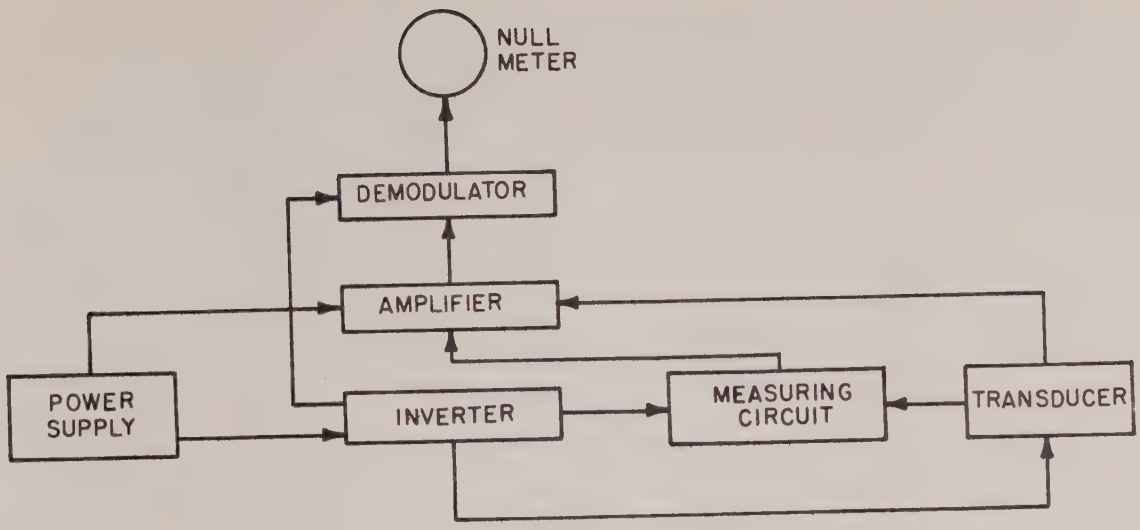

Fig. 3-1. Block Diagram

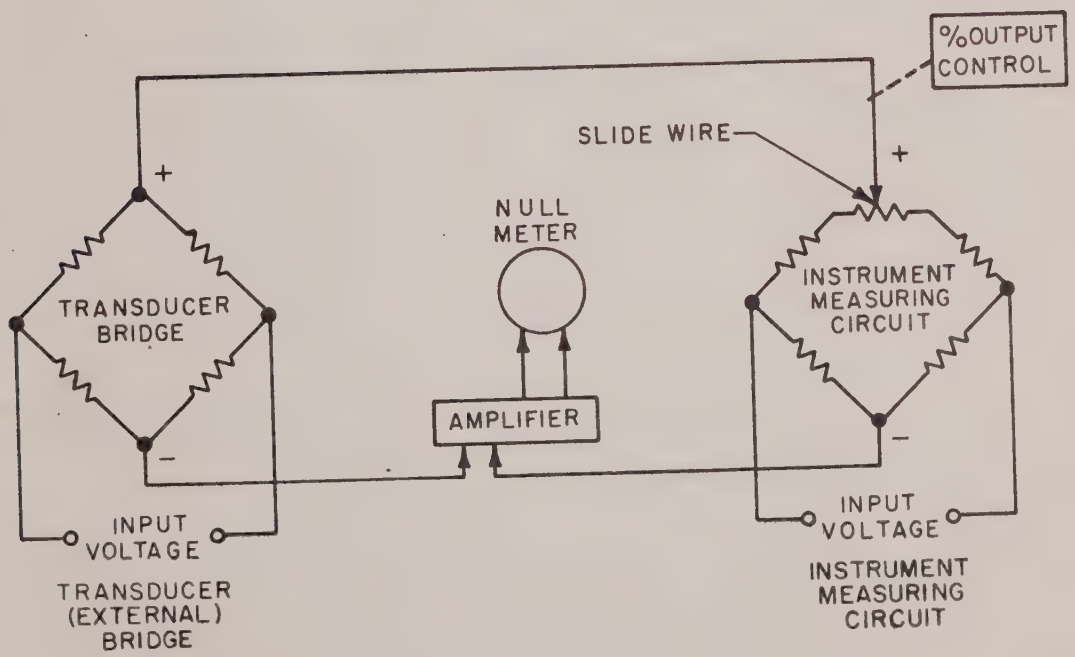

Fig. 3-2. Null-Balance, Functional Diagram

the slidewire until the measuring circuit output equals the Transducer output; at this point, the meter nulls. Since the null-meter operates in conjunction with the % OUTPUT control, its final position will be related to the position of the slidewire brush and, therefore, to the output of the Transducer.

3.2.1 Power Source (Battery)

Power to the inverter and amplifier is supplied by a 6-volt battery, Eveready No. 2317 or its equivalent. The battery power can be checked periodically by positioning the power switch to the check position. In this position, a portion of the battery voltage excites the null-meter. Satisfactory battery voltage is indicated by the meter needle deflecting to the right and beyond the red area. When battery voltage is low, the meter needle will fall in the red area indicating the need for replacing the battery.

3.2.2 Inverter

The DC-AC inverter, energized by the 6-volt battery, provides an AC output in the form of a square wave with a frequency of approximately 1,000 cycles. Four separate voltages are obtained from the output transformer. These are the 1 volt, 1.2 volt, 1.8 volt and 3 volt outputs. The 1 volt winding is the reference supply for the demodulator on the amplifier circuit board; the 1.2 and 1.8 volt windings supply the measuring circuit voltage; and the 3 volt winding excites the Transducer.

3.2.3 Amplifier

The amplifier input provides a single ended signal to the phase splitter Q1. This signal is amplified through two differential R-C coupled amplifier stages (Q2 and Q3, Q4 and Q5). R10 (a balancing potentiometer) balances the output of Q2 and Q3. The output of Q4 and Q5, limited to less than 1 volt peak-to-peak by a clipper formed by CR1 and CR2, is applied to the primary of transformer, T1.

The amplified signal passes from the amplifier section to the demodulator section or the amplifier circuit board. The demodulator produces a DC voltage to deflect the null-meter. The polarity and magnitude of this voltage is dependent upon the phase and magnitude of the difference between the Transducer and the measuring circuit voltages.

SECTION 4

MAINTENANCE

4.1 General

Periodic inspection or maintenance is not necessary except for checking and replacing the battery as required. The transistors, capacitors and resistors are operated well within their peak ratings and should give long, trouble-free operation.

4.2 Replacing Battery

Remove the Indicator from its case by removing the four screws in the front panel and carefully sliding the unit forward. The battery is located in the battery clip mounted at the bottom on the rear of the front panel. Remove the retaining spring from the battery clip and slide the battery out of the clip. Unsnap the leads and insert a new Eveready #2713N battery.* Slide the new battery into the clip and replace the retaining spring. Replace the Indicator in its case and secure it to its case with the four screws.

4.3 Troubleshooting the Transducer Indicator (Figure 4-1)

a. 4.3.1 Do not attempt to troubleshoot the Indicator prior to conducting the following checks:

a. Battery voltage (See Operation, Section 2, Paragraph 2.8.1).
b. Meter sensitivity (See Paragraph 4.3.1.1 below).
c. Transducer excitation voltage (voltage across BLACK and GREEN binding posts). See Paragraph 4.3.1.2 below).
d. Calibration Check (See Operation, Section 2, Paragraph 2.9)

*or NEDA # 1403, RCA # VS338

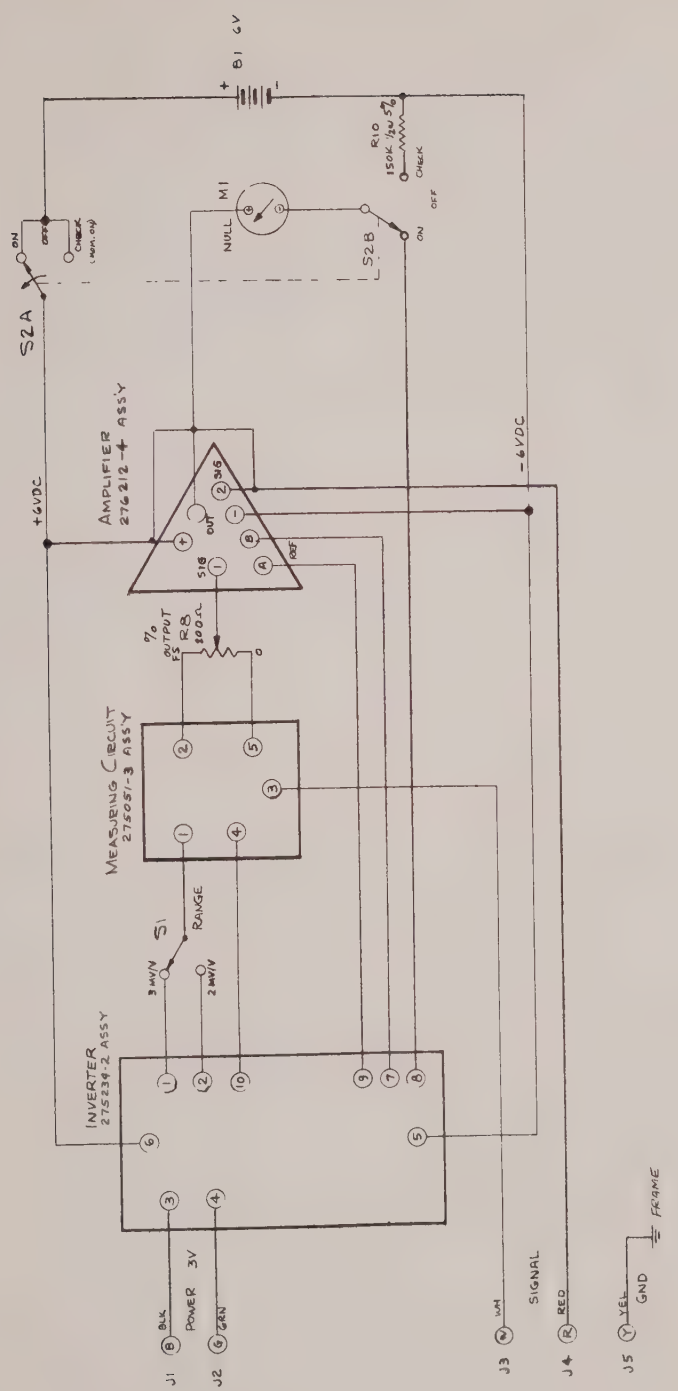

Figure 4-1. Model 352 Schematic Diagram

4.3.1.1 Meter Sensitivity Test

This check will indicate proper performance of the amplifier and measuring circuit.

a. Short the RED and WHITE binding posts with a clip lead.
b. The null-meter needle should be on zero (center of meter scale)
c. Turn the % OUTPUT knob until the meter needle is deflected full scale.
d. The dial should read approximately 0.5 to 1 percent.

4.3.1.2 Transducer Excitation Test

With a multimeter, such as a Simpson, check the voltage across the BLACK and GREEN binding posts. This should be approximately 3 volts RMS.

4.3.1.3

If any of the above tests indicate internal troubleshooting is necessary, it should be performed by a qualified electronic technician with the following equipment available for his use:

1. Simpson Model 260 Multimeter or its equivalent.
2. Tektronix oscilloscope with a high gain differential preamplifier.
3. Audio oscillator, Hewlett Packard Model 204B.
4. An accurate means of calibrating the instrument after repairs are made, such as a Baldwin Precision Calibrator Model 625.

4.3.2 Trouble Shooting Circuit Components

4.3.2.1 Trouble Shooting DC-AC Inverter (Figure 4-2)

This encapsulated unit can be checked without disconnecting it from the circuit or removing it from the instrument as follows:

a. Add a 120 ohm, 1/2 watt, ±10 percent resistor across the BLACK and GREEN binding posts.
b. Connect the oscilloscope, single ended, across the BLACK and GREEN binding posts.
c. The wave shape across the 120 ohm resistor should be a 8.5 volts P-P square wave with a frequency of 1000 CPS ±10 percent.
d. Check the measuring circuit supply voltage by placing the oscilloscope scope leads across pins 1 and 4 of the measuring circuit board. With the RANGE switch in the 2 mv/v position, the P-P square wave should be 4.3 volts. With the RANGE switch in the 3 mv/v position, the P-P square wave should be 5.04 volts.
e. Check the reference supply to the demodulator across pins 7 and 9 on the inverter or pins A and B on the amplifier board. This should read 2.8 volts P-P.

NOTE: This unit is not repairable. If malfunctioning, a new inverter must be ordered for replacement and the indicator recalibrated.

4.3.2.2 Trouble Shooting the Amplifier (Figure 4-3)

Remove the four screws that secure the amplifiers to the instrument chassis, one at each corner of the printed circuit board. Lay the amplifier on a flat insulated surface. Disconnect only the input signal leads, terminals 1 and 2.

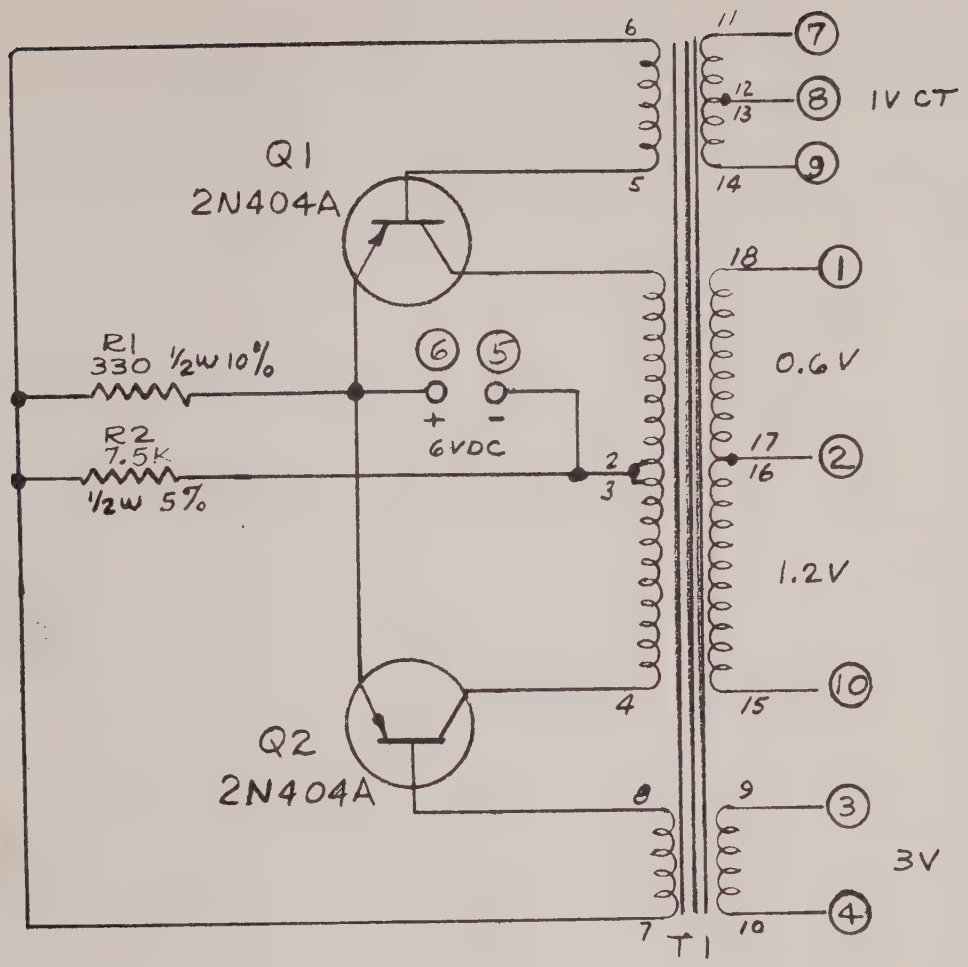

Figure 4-2. DC-AC Inverter Schematic Diagram

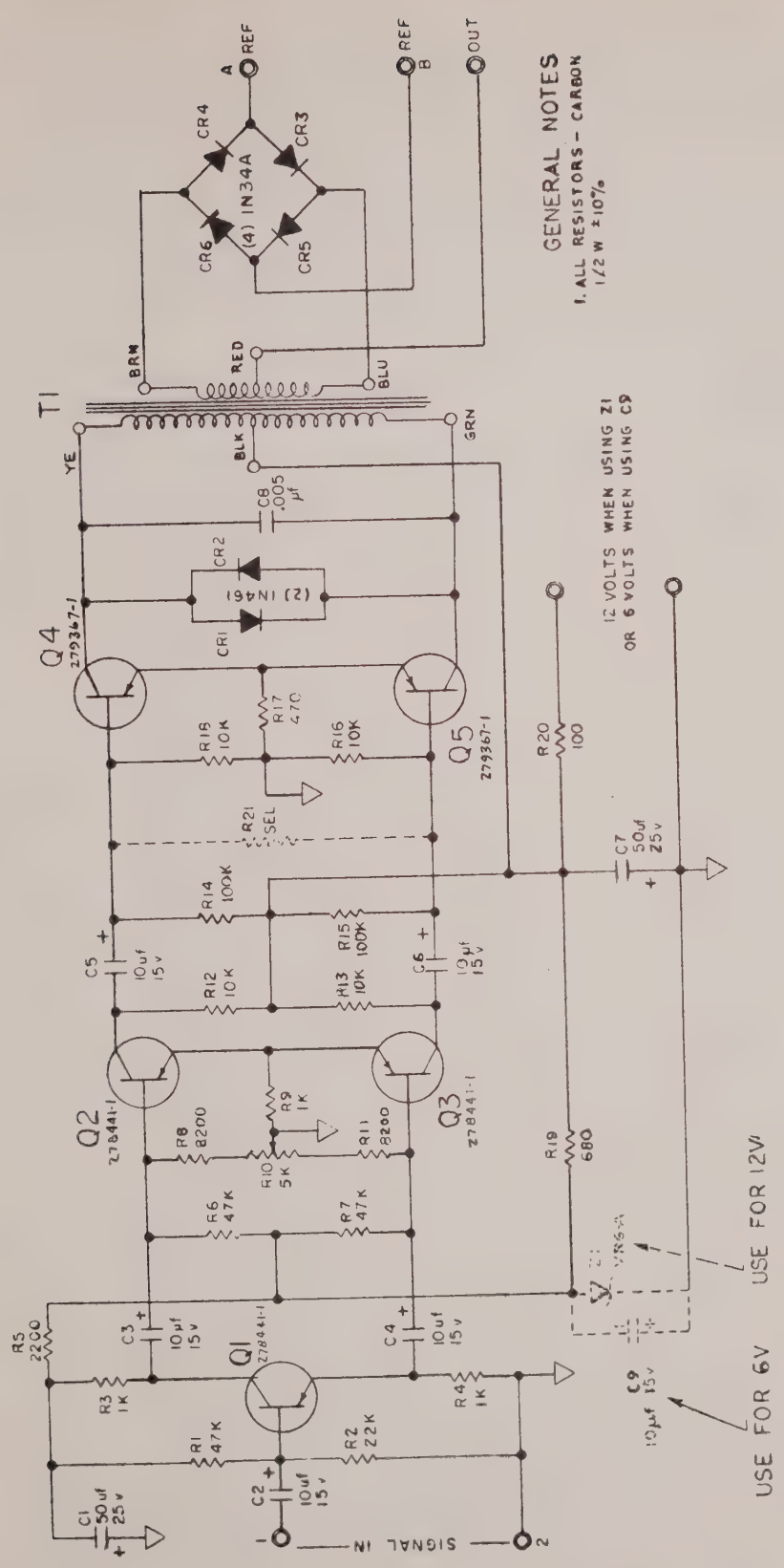

Figure 4-3. Amplifier Schematic Diagram

Connect an audio oscillator to the input terminals 1 and 2. Adjust the audio oscillator to provide an input voltage of approximately 20 micro-volts.

Using the oscilloscope in the differential mode, check each transistor stage by connecting the oscilloscope leads to each stage, collector to collector. Once the amplifier is repaired the adjustment below should be made.

Balance Adjustment - Short circuit the input terminals 1 and 2 with a jumper lead. Connect a Simpson Multimeter set to the 2.5 VDC Scale, across the collectors of Q2 and Q3. Adjust R10 until the voltage that is measured on the meter is less than 0.05 VDC. Remove the jumper lead on the input terminals 1 and 2.

4.3.2.3 Trouble Shooting the Measuring Circuit Board (Figure 4-4)

The only malfunction that could occur on the Measuring Board would be a resistor shorted, opened or broken. The easiest method to troubleshoot the resistors is to turn off the power in the instrument and perform a continuity test with a Simpson Multimeter. Once the trouble is located and repaired, the instrument should be returned to BLH Electronics for recalibration, since these resistors are in the precision measuring circuit and different resistors may change the basic calibration.

If the trouble cannot be found easily, send the instrument to BLH Electronics for repair and recalibration.

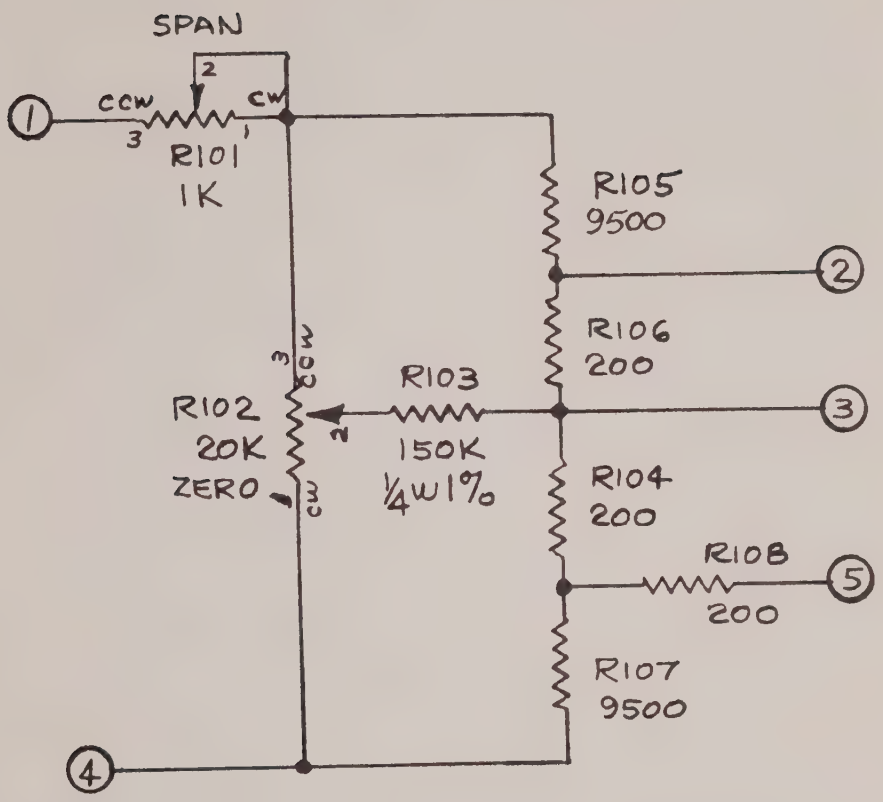

Figure 4-4. Measuring Circuit Schematic Diagram

SECTION 5
LIST OF REPLACEABLE PARTS

GENERAL

Circuit Symbol	Description	BLH Part No.
B1	6-volt Battery	135470-8
DS-R8	Dial, Turn Counting	135674-8
J1	Binding Post, Black	135149-8
J2	Binding Post, Green	135150-8
J3	Binding Post, White	135146-8
J4	Binding Post, Red	135145-8
J5	Binding Post, Yellow	135148-8
M1	Null-Meter	402880-1
R8	Potentiometer, 10 Turn, 200Ω	135359-8
S1	Switch, Range	132959-8
S2	Switch, Power	135469-8
	DC-AC Inverter, Encapsulated Assy	275234-2
	Amplifier Assembly	276212-4
	Measuring Board Assembly	275051-3

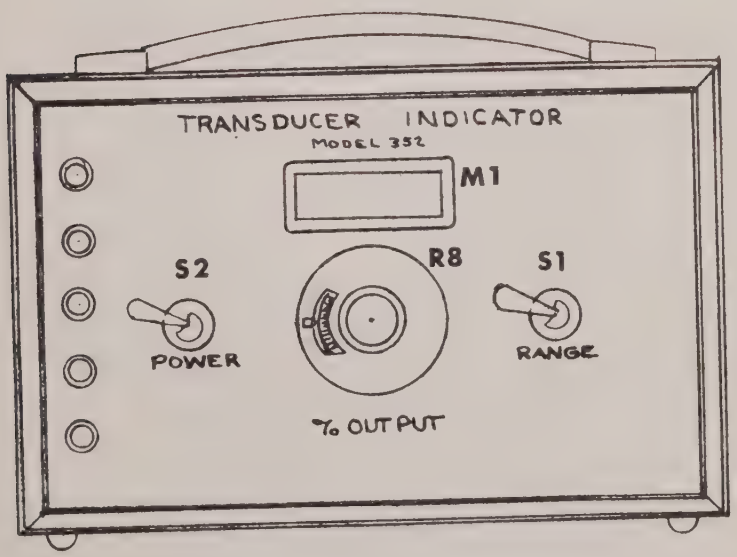

Figure 5-1. Indicator Panel Component Location

MEASURING BOARD ASSEMBLY

Circuit Symbol	Description	BLH Part No.
R101	Potentiometer, 1K ohms	135563-8
R102	Potentiometer, 20K ohms	135564-8
R103	Resistor, 150K, 1/2 W, 1%	127448-8
R104	Resistor, Prec. W.W., 200Ω 1/4 W, 1/2%	134096-8
R105	Resistor, Prec. W.W. 9500Ω 1/4 W, 1/2%	134097-8
R106	Same as R104	
R107	Same as R105	
R108	Same as R104	
R10	Resistor, Comp, 150K, 1/2W, 5%	129905-8

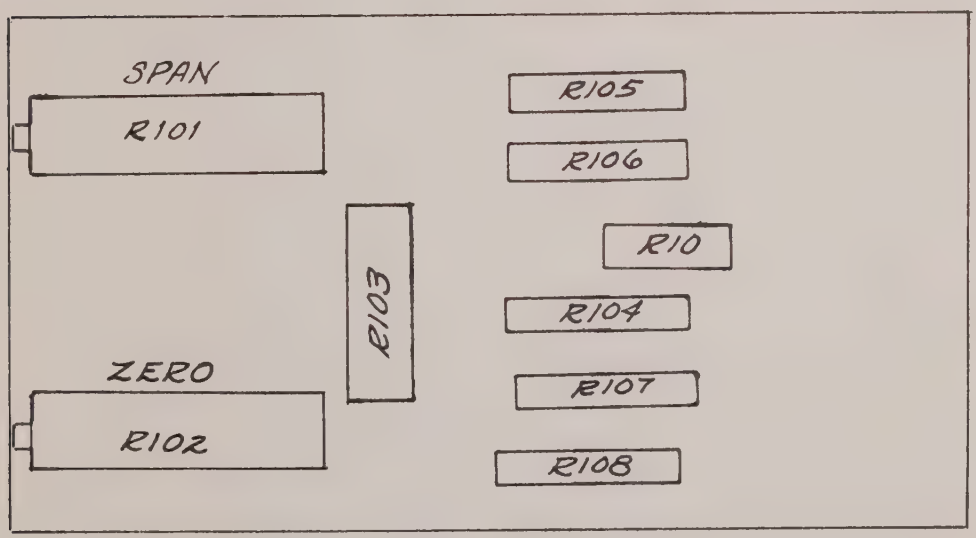

Figure 5-2. Measuring Board Assembly, Component Location

AMPLIFIER ASSEMBLY

Circuit Symbol	Description	BLH Part No.
C1	Capacitor (50 µf, 25V)	135381-8
C2	Capacitor (10 µf, 15V)	135385-8
C3	Capacitor (10 µf, 15V)	135385-8
C4	Capacitor (10 µf, 15V)	135385-8
C5	Capacitor (10 µf, 15V)	135385-8
C6	Capacitor (10 µf, 15V)	135385-8
C7	Capacitor (50 µf, 25V)	135381-8
C8	Capacitor (0.005 µf, 500V)	135386-8
C9	Capacitor (10 µf, 15V)	135385-8
CR1	Diode, IN461	135387-8
CR2	Diode, IN461	135387-8
CR3	Diode, IN34A	135388-8
CR4	Diode, IN34A	135388-8
CR5	Diode, IN34A	135388-8
CR6	Diode, IN34A	135388-8
Q1	Transistor, 2N404	278441-1
Q2	Transistor, 2N404	278441-1
Q3	Transistor, 2N404	278441-1
Q4	Transistor, 2N404	278441-1
Q5	Transistor, 2N404	278441-1
R1	Resistor, Carbon (47K, 1/2 watt, 10%)	127238-8
R2	Resistor, Carbon (22K, 1/2 watt, 10%)	127234-8
R3	Resistor, Carbon (1K, 1/2 watt, 10%)	127218-8
R4	Resistor, Carbon (1K, 1/2 watt, 10%)	127218-8
R5	Resistor, Carbon (2.2K, 1/2 watt, 10%)	127222-8
R6	Resistor, Carbon (47K, 1/2 watt, 10%)	127238-8
R7	Resistor, Carbon (47K, 1/2 watt, 10%)	127238-8
R8	Resistor, Carbon (8.2K, 1/2 watt, 10%)	127229-8
R9	Resistor, Carbon (1K, 1/2 watt, 10%)	127218-8
R10	Potentiometer (5K, 1/2 watt, 10%)	135384-8
R11	Resistor, Carbon (8.2K, 1/2 watt, 10%)	127229-8
R12	Resistor, Carbon (10K, 1/2 watt, 10%)	127230-8
R13	Resistor, Carbon (10K, 1/2 watt, 10%)	127230-8
R14	Resistor, Carbon (100K, 1/2 watt, 10%)	127242-8
R15	Resistor, Carbon (100K, 1/2 watt, 10%)	127242-8
R16	Resistor, Carbon (10K, 1/2 watt, 10%)	127230-8
R17	Resistor, Carbon (470Ω, 1/2 watt, 10%)	127214-8
R18	Resistor, Carbon (10K, 1/2 watt, 10%)	127230-8
R19	Resistor, Carbon (680Ω , 1/2 watt, 10%)	127216-8
R20	Resistor, Carbon (100Ω , 1/2 watt, 10%)	127206-8
R21	Resistor, Carbon (SEL, 1/2 watt, 10%)	Select
T1	Transformer	276178-1

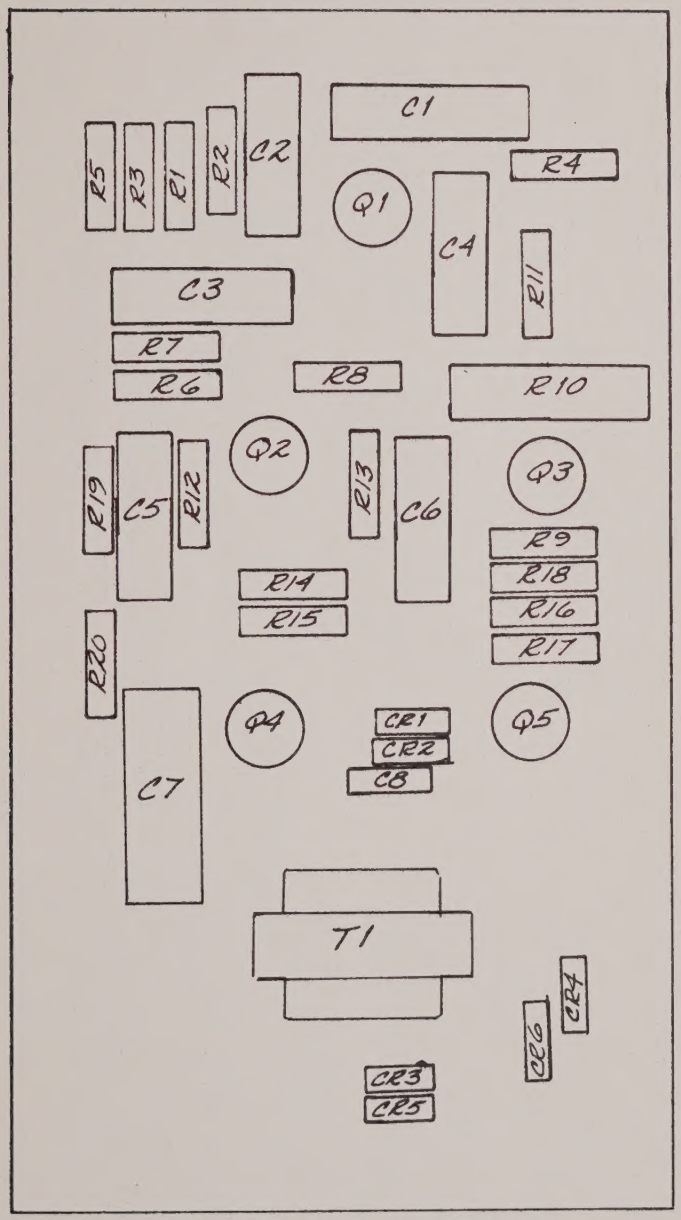

Figure 5-3. Amplifier Assembly, Component Location